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A Recipe for Success in the Vestibular Clinic – Clinical Decision Analysis Techniques and Care Path

Julie Honaker, PhD CCC-A



Julie Honaker, PhD, CCC-A

Julie A. Honaker, Ph.D. CCC-A is the Section Head of Audiology, Head and Neck Institute, and the Director of the Vestibular and Balance Disorders Program at the Cleveland Clinic. Her passion for vestibular sciences developed during her master's program in audiology (2001) and Ph.D. (2006) at the University of Cincinnati, followed by a post-doctoral fellowship at the Mayo Clinic (2009). Prior to joining the Cleveland Clinic in 2016, she was an Associate Professor at the University of Nebraska-Lincoln with her teaching and research program focused on vestibular and balance sciences. As a clinical researcher, she strives to advance the care of patients with balance disorders, but more importantly, she mentors students to become independent and critical thinkers and consumers, and producers of research. Her significant contributions to the field are enhancing the clinical training and research preparedness of students in audiology. Dr. Honaker is currently serving as the American Speech-Language-Hearing Association Vice President for Academic Affairs in Audiology.

Disclosures

- **Presenter Disclosure:** Financial: Julie Honaker is an employee of the Cleveland Clinic. She is a published author and receives royalties for her book “Diagnostic Vestibular Pocket Guide”. She received an honorarium for this course. Non-financial: Julie Honaker has no relevant non-financial relationships to disclose.
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Learning Outcomes

After this course, participants will be able to

- Identify best-practice protocols for assessing patients in the vestibular clinic.
- Discuss current trends in objective vestibular measures.
- Discuss the application of clinical decision analysis to vestibular assessment.

Patients with dizziness and imbalance concerns present a diagnostic challenge

Neurologic

- Stroke and TIAs
- Multiple sclerosis
- Migraines
- Hydrocephalus

Eye

- Double vision
- Cataracts
- Vision loss of any type

Ear

- Hearing loss
- Vestibular Disorders

Medications

- Type
- Number

Cardio-pulmonary

- Heart disease/failure
- COPD

Musculoskeletal

- Neck or back injuries
- Arthritis

Diabetes

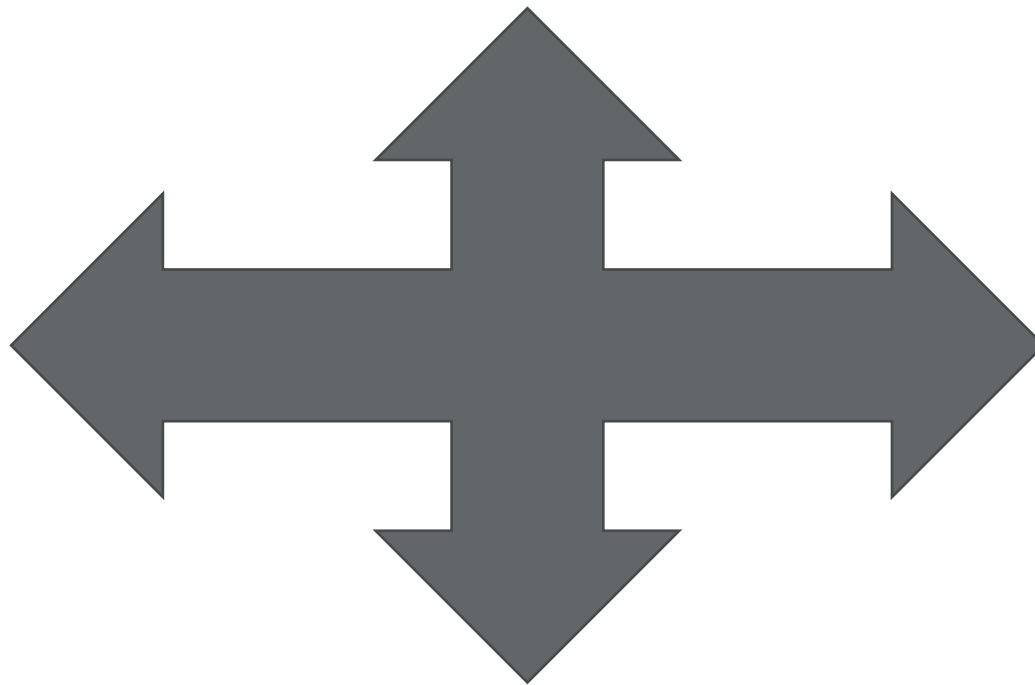
- Neuropathy
- Vision loss

Mental Health

- Depression
- Anxiety
- Panic
- Fear of Falling

Clinical dilemma

Multiple paths without a clear
clinical practice guideline



Clinical Practice Guidelines: Benign Paroxysmal Positional Vertigo (Update)

Bhattacharyya et al. (2017), Otolaryngology Head
and Neck Surgery, Vol 156 (3S): S1-S47

Benign Paroxysmal Positional Vertigo

If BPPV testing is positive and only symptom is brief motion-provoked vertigo, then

No further vestibular testing is necessary (Grade II).

Follow-up in 1-2 weeks after treatment with phone call or face-to-face visit (Grade II).

Treatment for BPPV Grade (I)

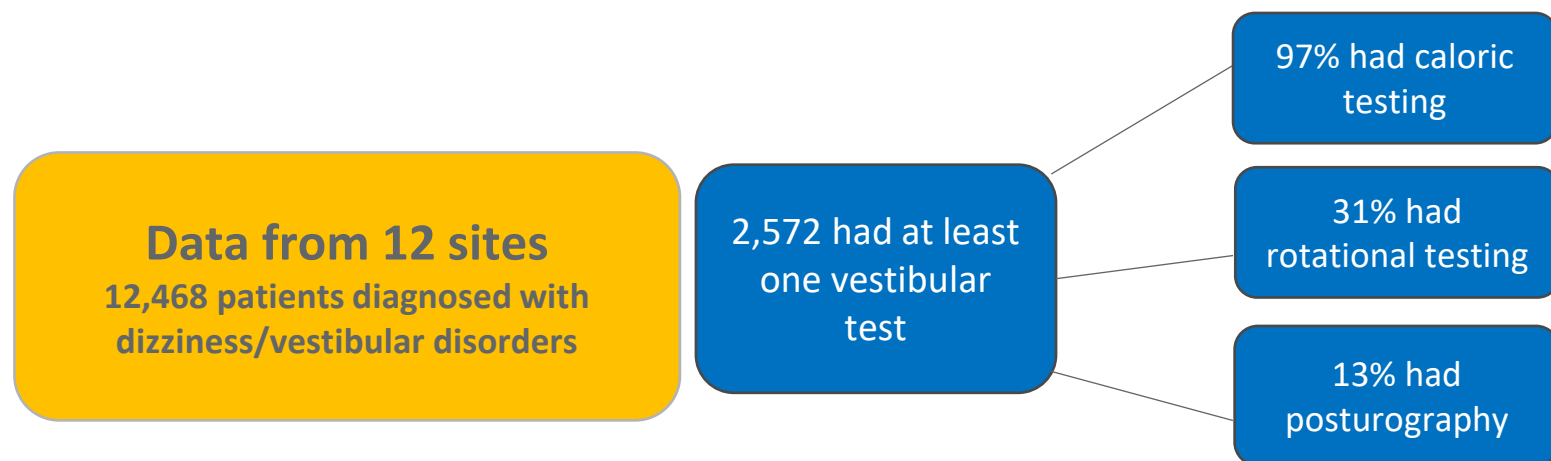
Important Note

**BPPV resolved, but still sx complaints
OR intractable BPPV**

- Further vestibular testing warranted

Objective Vestibular Measures

- Commonly performed to evaluate dizziness and imbalance concerns BUT
 - Varied use by geographic regions, specialties, sites
 - Over or under utilization
- Piker et al. 2016:



Recommended that clinical documentation include the following:

1. Justification of medical necessity
2. Justification of skilled services
3. Justification of functionality & value

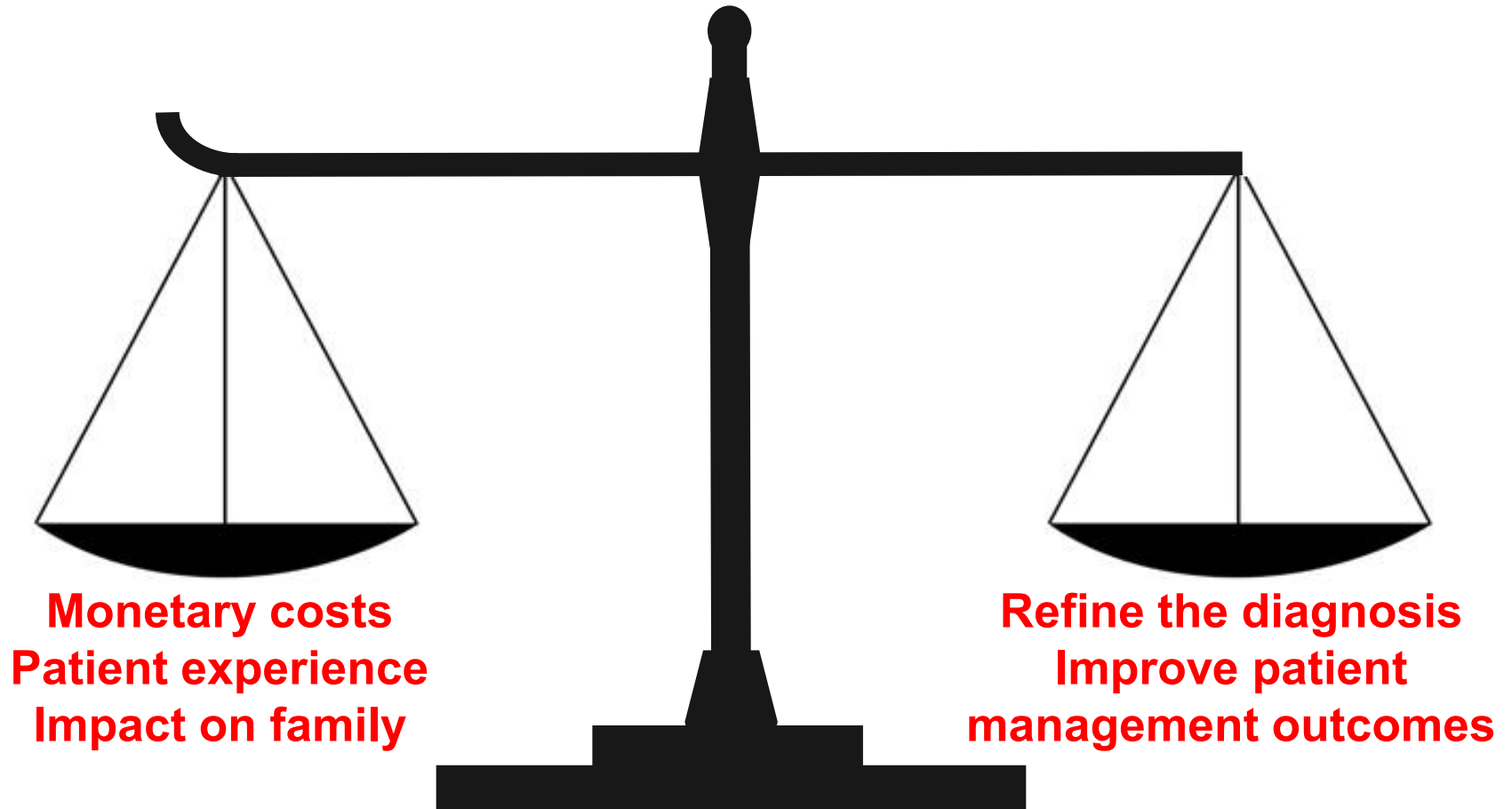
Justification
Medical
Necessity

“Services which are not reasonable and necessary for the diagnosis or treatment of illness or injury or to improve the functioning of a malformed body member are not covered”

(Centers for Medicare & Medicaid Services)

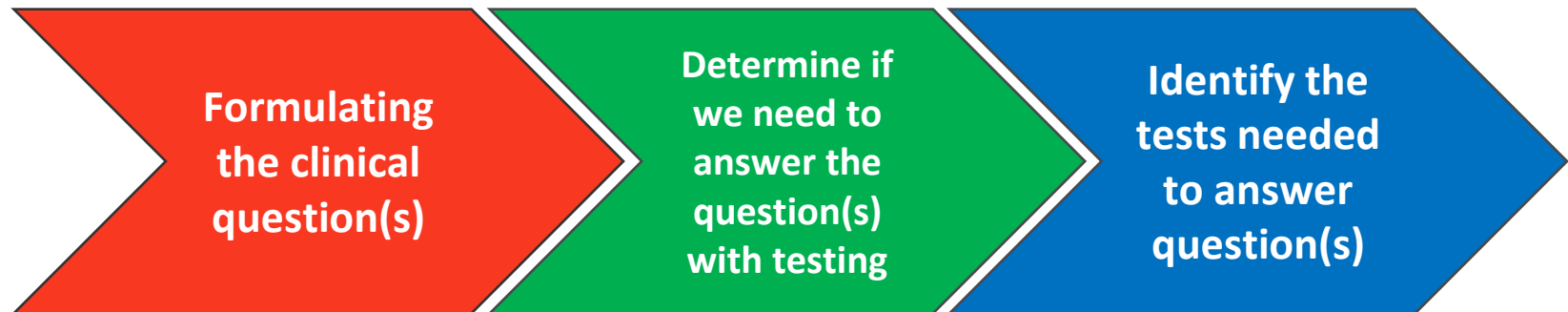
Diagnoses should be guided by patient symptoms and office examination AND

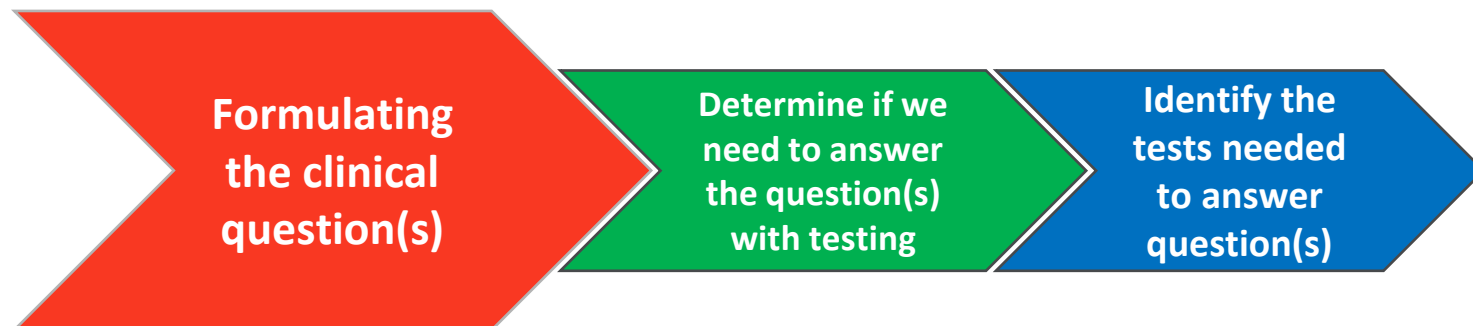
Objective testing should only be performed if clinically indicated



Vestibular testing decision making

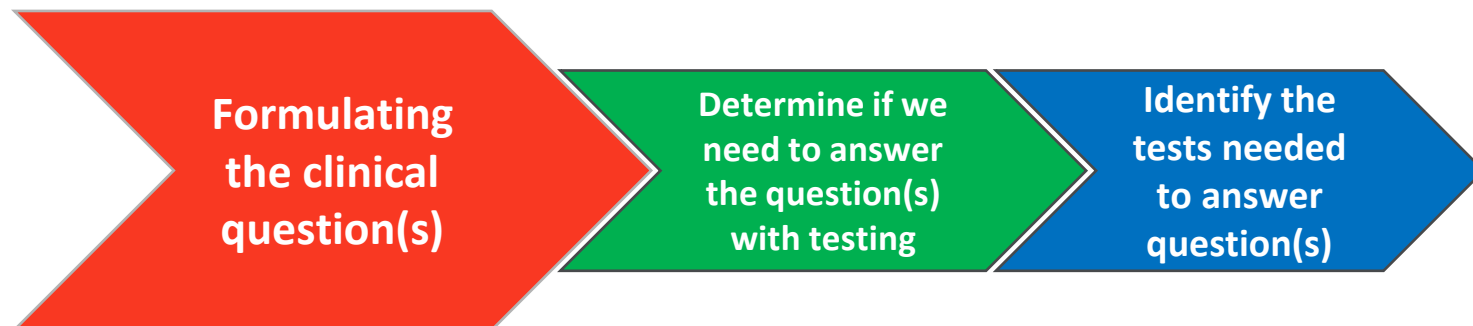
To determine what testing to perform we need to do the following:





Formulating the clinical question:

- Specific to gear evaluation toward possible answers
- Most questions developed during case history, pre-planning/chart review simplifies the process



Example:

- Patient presents with movement provoked symptoms of dizziness and unsteadiness for one month prior to evaluation
- Medical record review reveals negative associated symptoms or neurological complaints
 - Clinical question(s) may include:
 - Is benign paroxysmal positional vertigo (BPPV) suspected?
 - Is there evidence of uncompensated vestibular system hypo/hyperfunction?

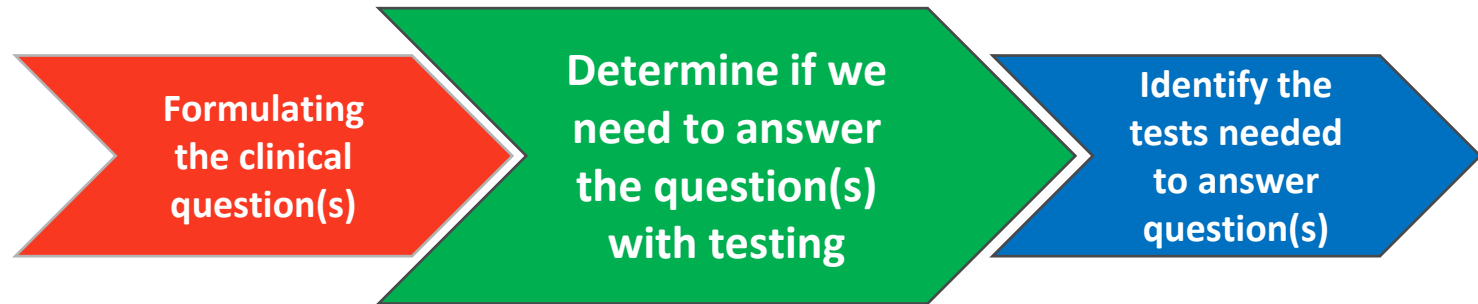
Key components to include in the review/case history:

- Description of symptoms
- Duration and frequency of symptoms
- Initial onset of symptoms
- Imaging results
- Associated symptoms (e.g., hearing loss, neurological complaints)
- Visual history and current concerns
- Auditory history and current concerns
- History of falls
- Medical problem list or comorbidities
- Family/social history
- Past vestibular assessment and results
- Past treatment (e.g., physical therapy, medications) and treatment outcome
- Possible medication effects
- Other pertinent information to formulate the clinical question(s)

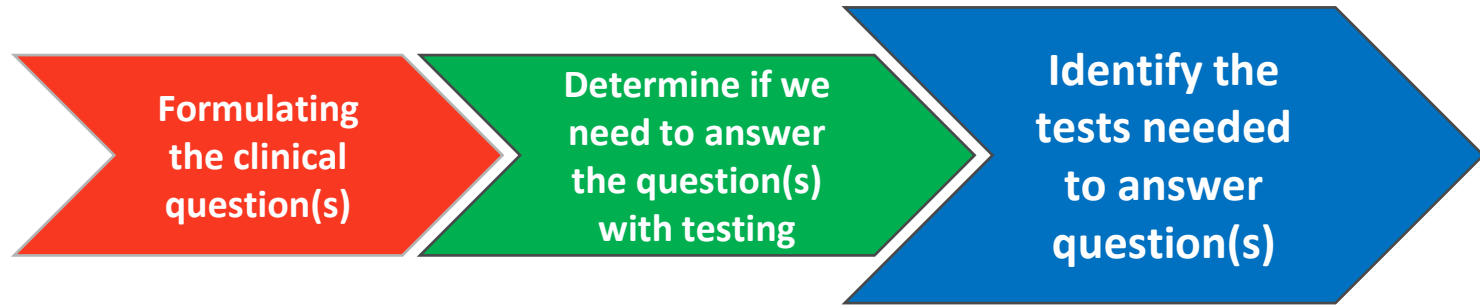
Diagnosis Hypothesis	Symptom Characteristics	Clinical question(s)
Benign paroxysmal positional vertigo (BPPV)	• Vertigo triggered with positional changes that lasts <i>seconds to minutes</i> in duration	• Any objective evidence of BPPV? • If yes, what is the most appropriate treatment approach?
Bilateral vestibulopathy	• Unsteadiness when walking or standing, increased symptoms in darkness and on uneven surfaces • Oscillopsia with head and body movements • Typically lack of symptoms when still	• Is there bilaterally impaired VOR? • Any central signs to account for symptoms?
Unilateral vestibulopathy	• Spontaneous episode of vertigo/imbalance lasting <i>hours to days</i>, resolving to head and body provoked symptoms within days	• Any unilateral peripheral vestibular system involvement? If yes, to what extent (isolated or global loss)? • What is the status of compensation?
Central disorders	• Slow onset imbalance • Sudden onset of symptoms with neurologic complaints (diplopia, dysphasia, dysarthria, dysmetria etc.) • Oscillopsia • Head/body provoked symptoms	• Any signs of oculomotor system dysfunction? • Any evidence of impaired vestibular function?

Direct Office Exam

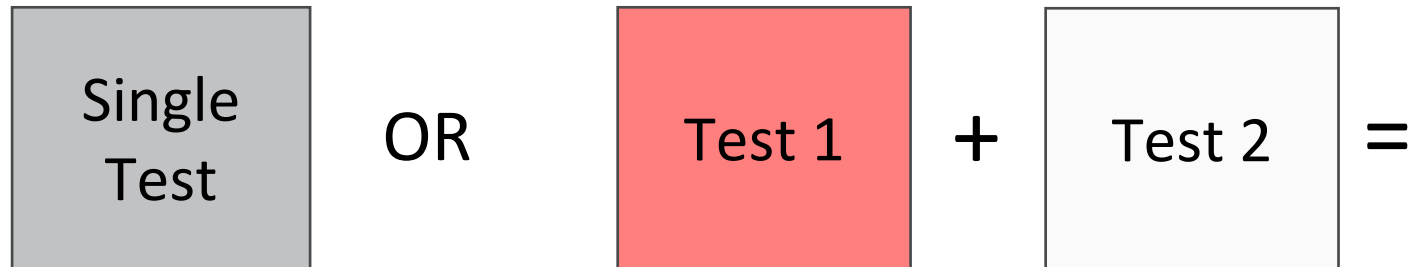
Unilateral Peripheral Vestibular	Bilateral Peripheral Vestibular	Central Disorders
• Direction fixed jerk nystagmus - predominantly horizontal/horizontal torsional, • enhanced with fixation removed, and follows Alexander's law	• No observed nystagmus	• Direction changing jerk nystagmus, nystagmus enhanced with fixation, and nystagmus that is pure vertical or torsional
• Ocular tilt reaction (OTR): skew deviation, head tilt and ocular counterrolling toward lesion side	• Abnormal dynamic visual acuity screening (> 3 line difference)	• Saccadic intrusions/oscillations or other nystagmus patterns (e.g., pendular nystagmus)
• Jerk nystagmus with horizontal headshake and/or mastoid vibration that beats away from the involved side	• No observed nystagmus with horizontal headshake and/or mastoid vibration	• Pure vertical nystagmus induced with horizontal headshake or mastoid vibration
• Reduced VOR responses toward the side of the lesion (head impulse)	• Reduced VOR responses when stimulating right and left sides	• Normal VOR responses
• Impaired postural control when relying on vestibular system (eyes closed, foam surface)	• Impaired postural control when relying on vestibular system (eyes closed, foam surface)	• Acutely unable to stand without assistance; severely impaired postural control
• Impaired gait performance with head turns toward lesioned side	• Impaired gait performance with head turns toward both sides	• Acutely unable to walk without assistance/ataxic gait
• Normal oculomotor performance	• Normal oculomotor performance	• Abnormal oculomotor performance



- What answers can we obtain with vestibular testing?
- Aids in determining:
 - Site of lesion localization
 - Assessment of functional ability to use system input/output
 - Status of compensation
 - Extent of lesion or residual function
- Confirmatory for that suspected from history, audiometry and direct exam
- Drives management decisions
- Decision process during treatment



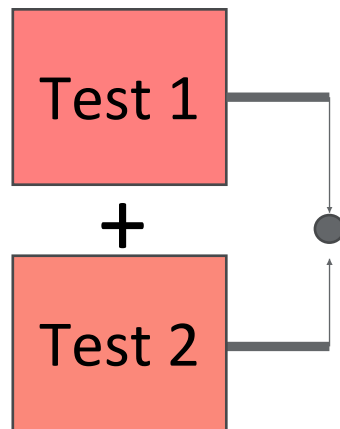
Clinical Decision Analysis



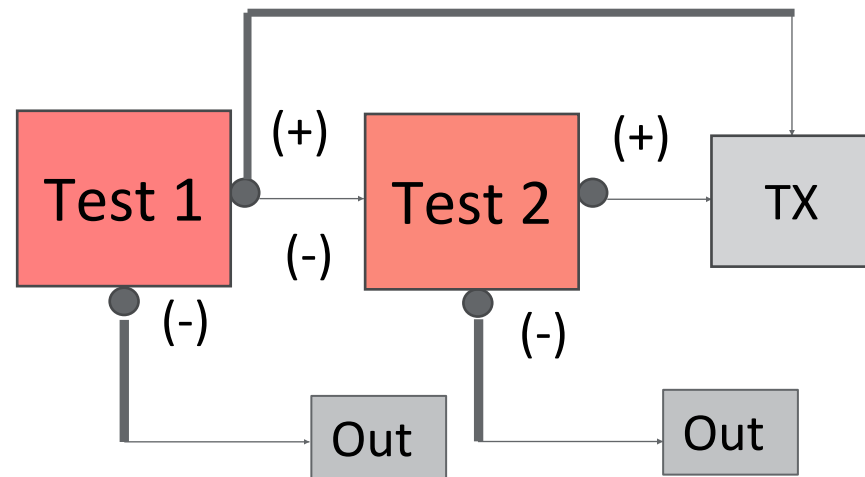
Improved Diagnostic Accuracy

Clinical Decision Analysis

Parallel Protocol

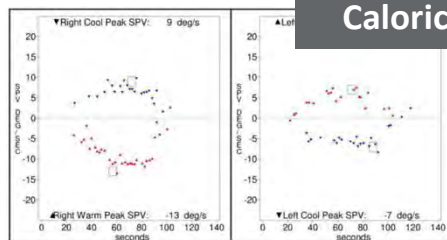


Series Protocol

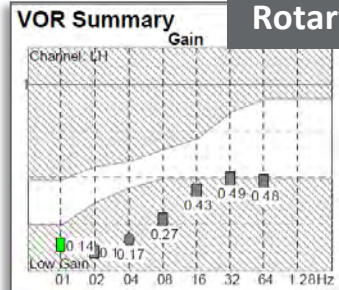


Identify the tests needed to answer question(s)

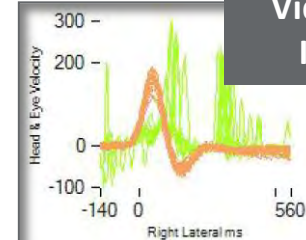
Calorics



Rotary Chair

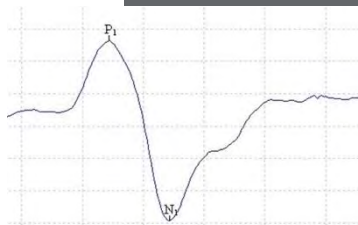


Video Head Impulse

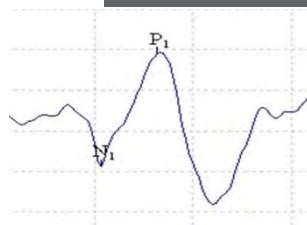


Otolith tests

Cervical VEMPs

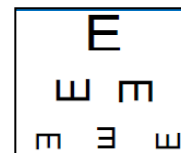


Ocular VEMPs



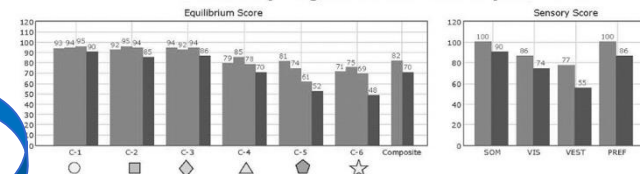
Functional tests

Dynamic Visual Acuity



Posturography

Sensory Organization Test Report



C-1 = Condition 1, C-2 = Condition 2, C-3 = Condition 3, C-4 = Condition 4, C-5 = Condition 5, C-6 = Condition 6
SOM = Somatosensory, VIS = Visual, VEST = Vestibular, PREF = Preference, COG = Center of Gravity

Identify the tests needed to answer question(s)

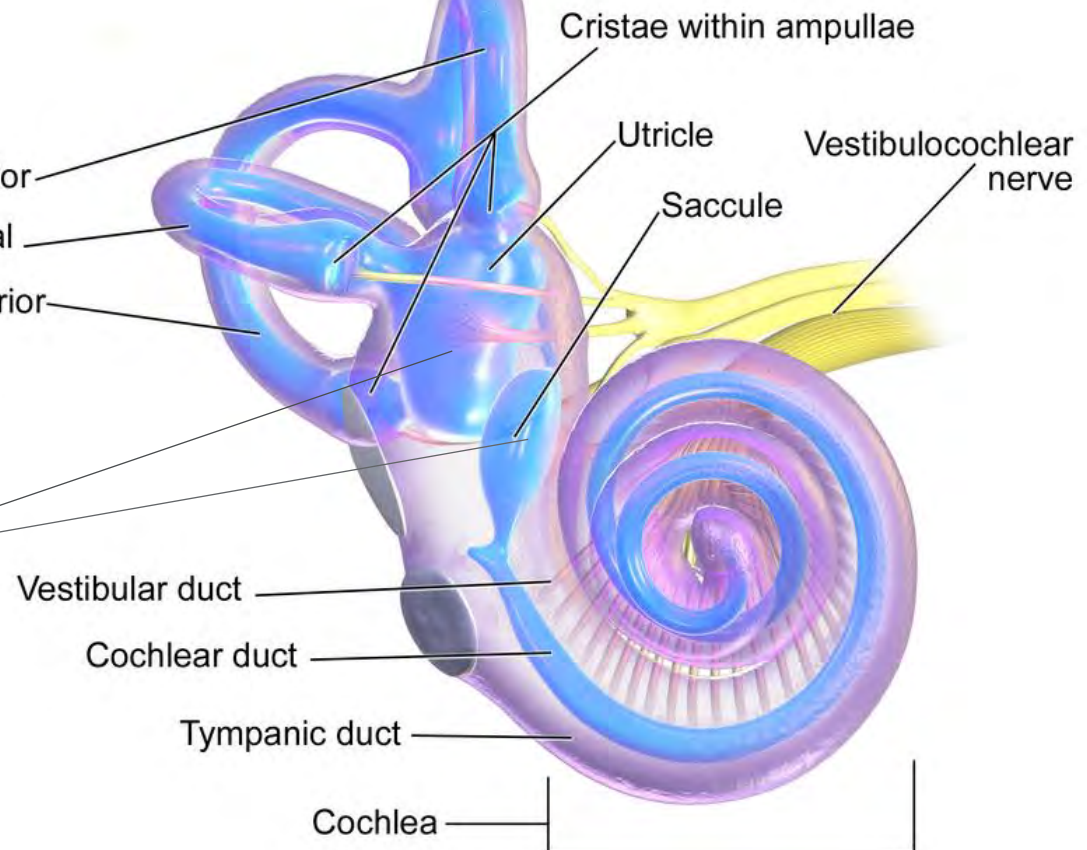
Semi-circular canals

Convert angular acceleration & deceleration into electrical code

Anterior
Lateral
Posterior

Otolith Organs

Convert linear acceleration & deceleration into electrical code



Identify the
tests needed
to answer
question(s)

Superior Nerve

Horizontal canal:

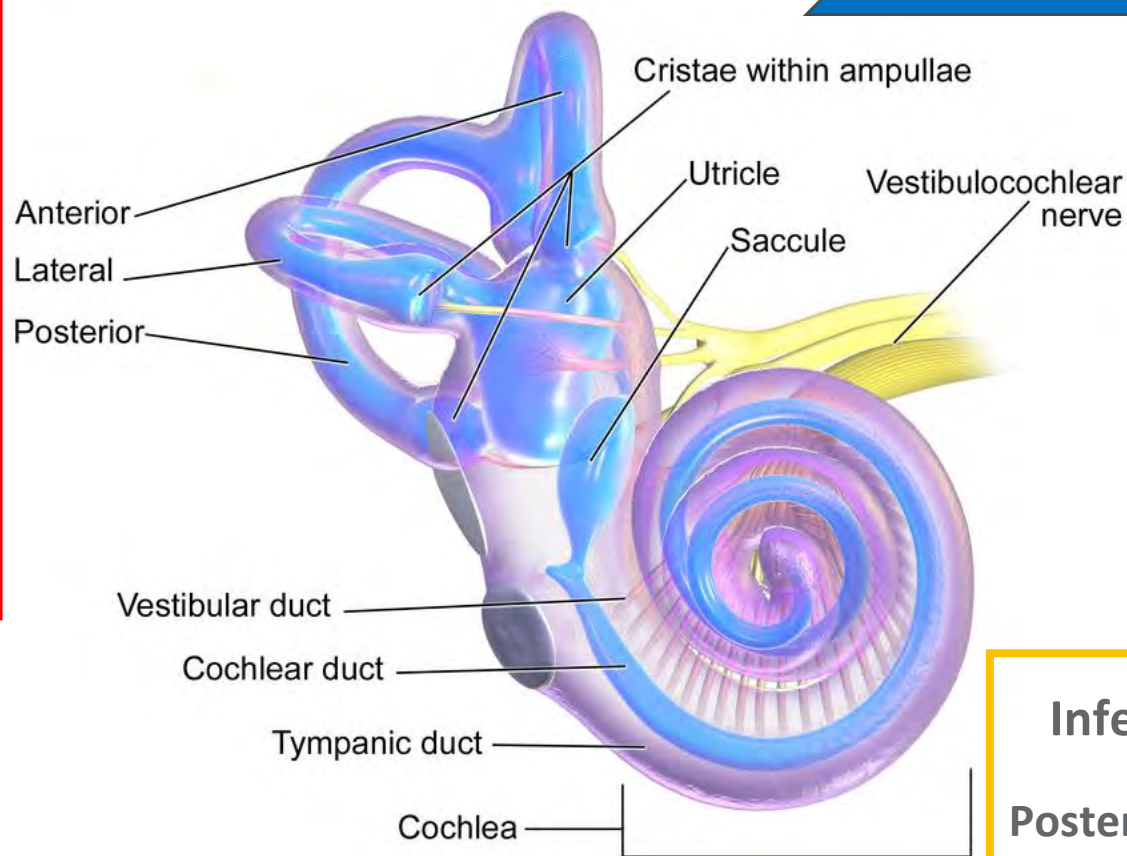
- caloric, rotary chair, vHIT

Anterior canal:

- vHIT

Utricle:

- ocular VEMP



Inferior Nerve

Posterior canal:

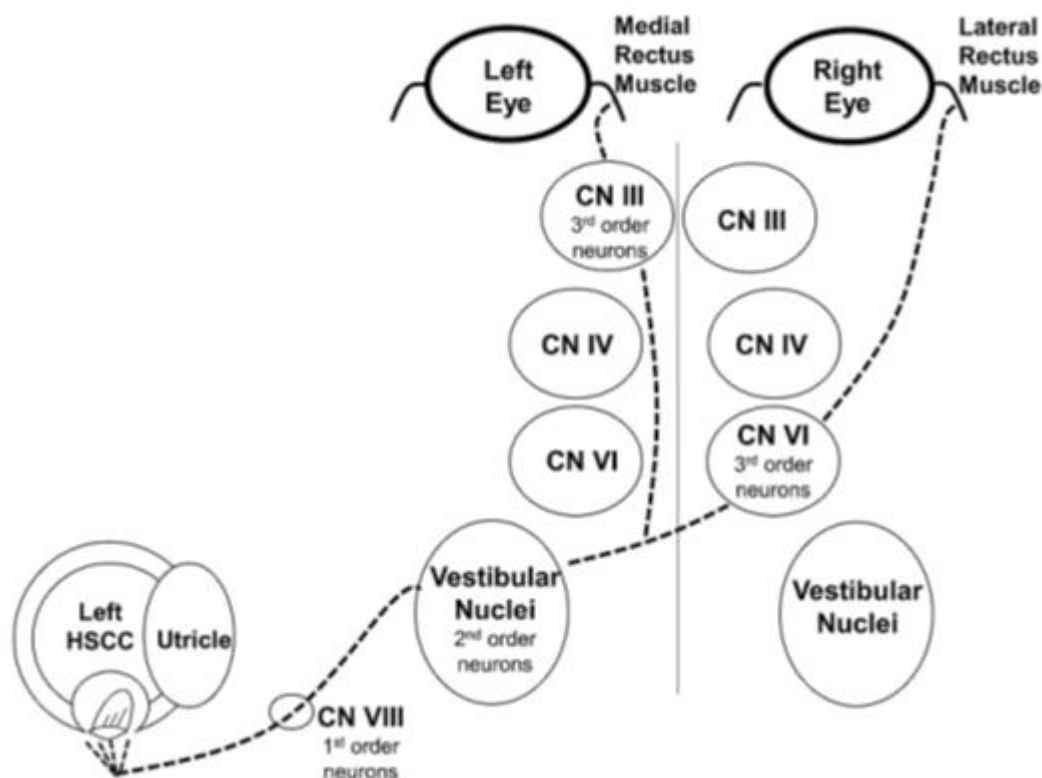
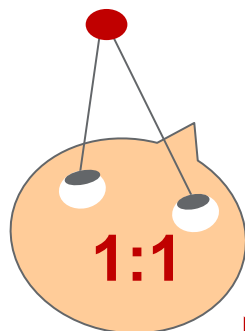
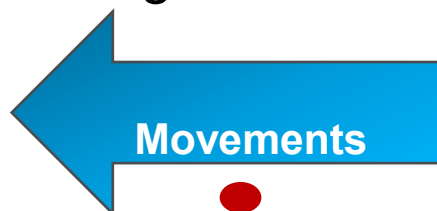
- vHIT

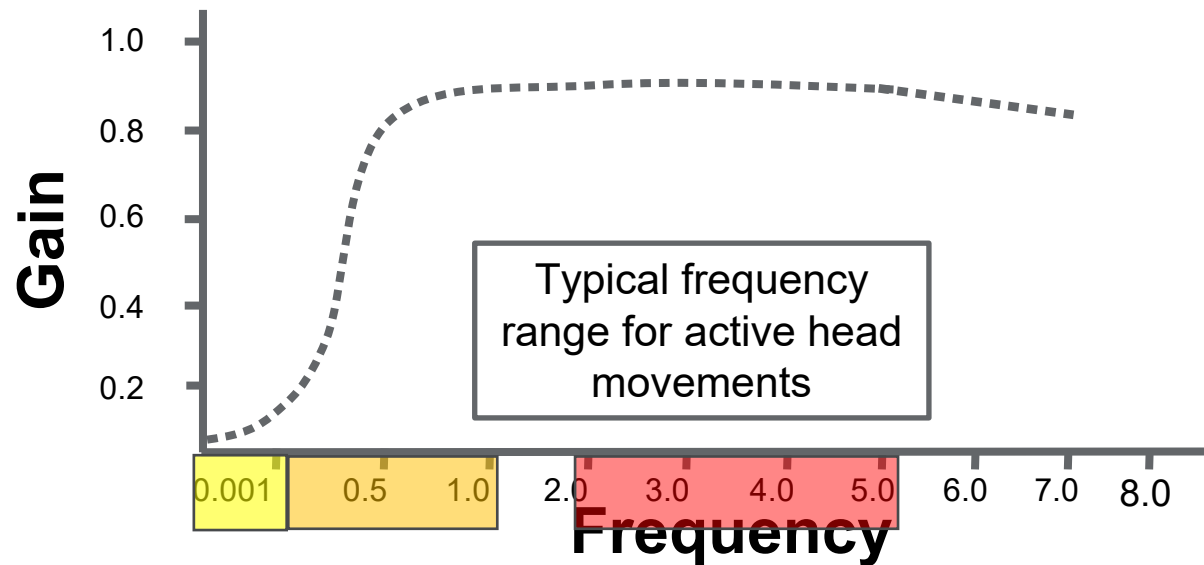
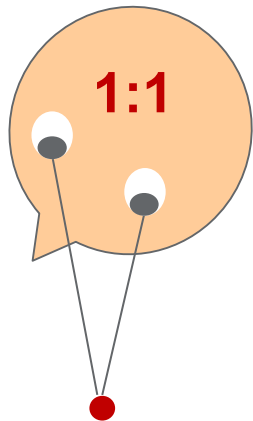
Saccule

- cervical VEMP

Vestibulo-ocular Reflex (VOR)

Helps to maintain steady vision during head movements





Caloric

**Rotary
Chair**

**Video Head
Impulse Test (vHIT)
DVAT**

VNG/ENG

Bedside Exam

Ocular motor

Gaze

Saccades

Pursuit Tracking

Optokinetic

Spontaneous fixation removed

Hyperventilation

Dix-Hallpike
and Roll tests

Head shake nystagmus testing

Positional nystagmus testing

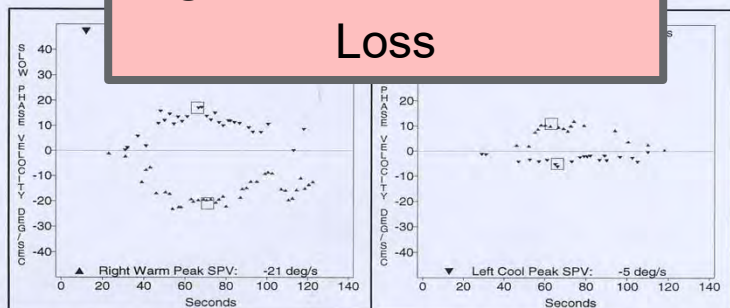
Caloric testing

Calorics

Important Note

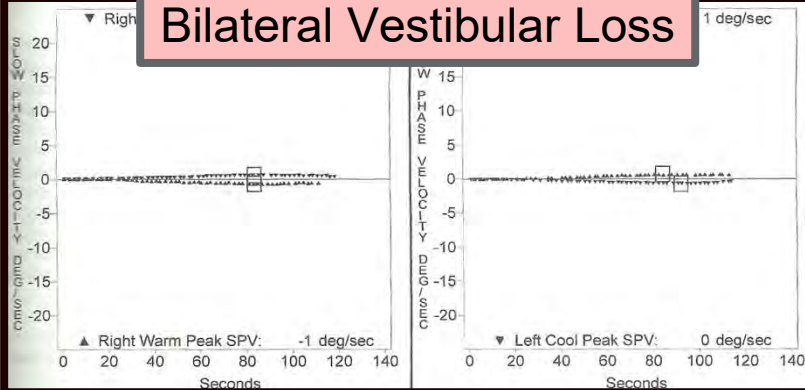
Low frequency response of angular VOR (limited to horizontal canal/superior vestibular nerve function)

Unilateral Vestibular Loss

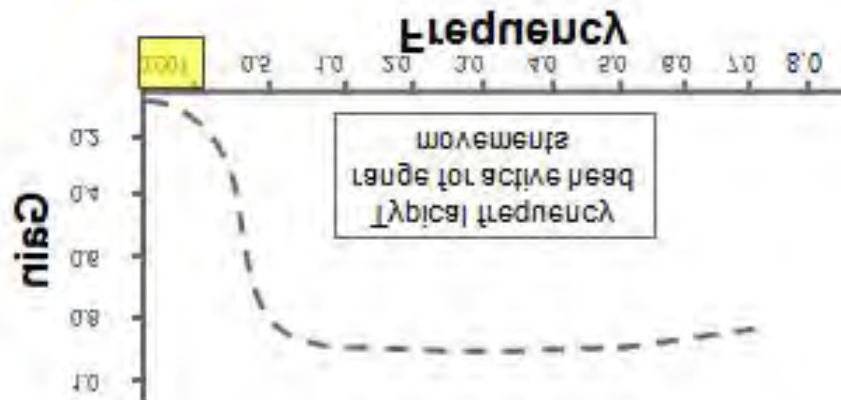


Fixation Index: RC=" LC=" RW=" LW="; Caloric Weakness: 41% in the left ear
Directional Preponderance: 4% to the left

Bilateral Vestibular Loss

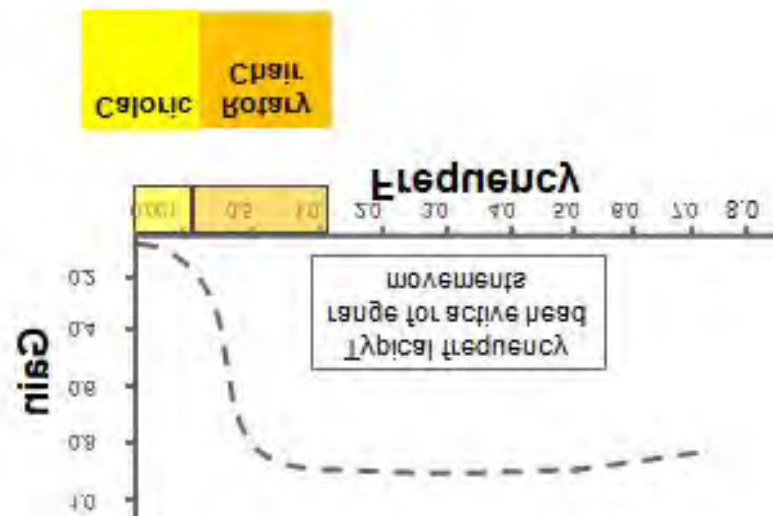


Caloric



Rotational Chair

- Further evaluation of peripheral vestibular system
- Bilateral weakness
- Unable to complete calorics
- Pediatrics



Important Note

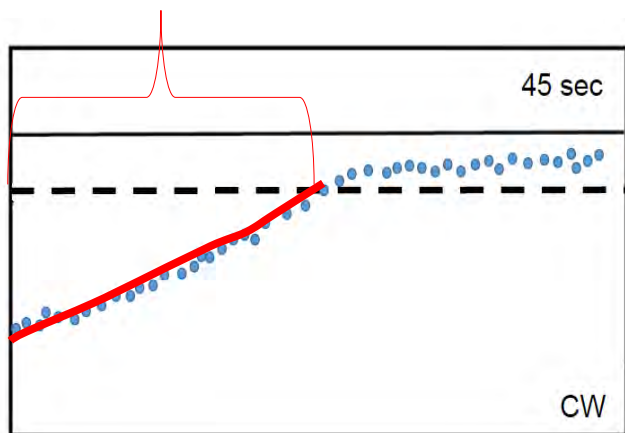
Low to mid frequency response of angular VOR (limited to horizontal canal/superior vestibular nerve function)

Rotational Chair

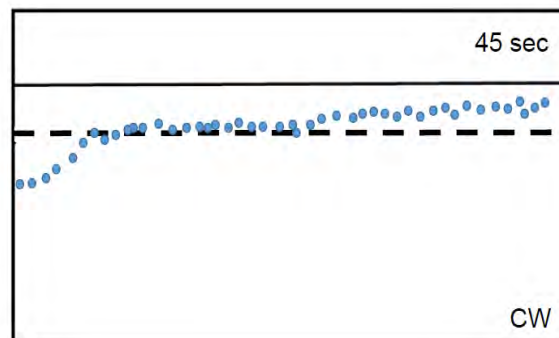
- **Step Velocity Testing**



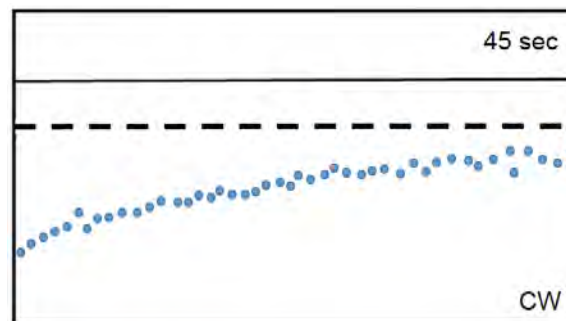
- Examines system time



Shortened TC values = peripheral



Prolonged TC values =
central/migraines/motion sensitivity

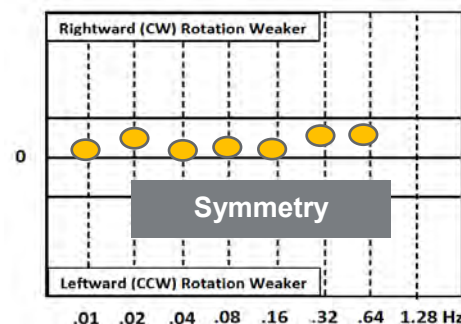
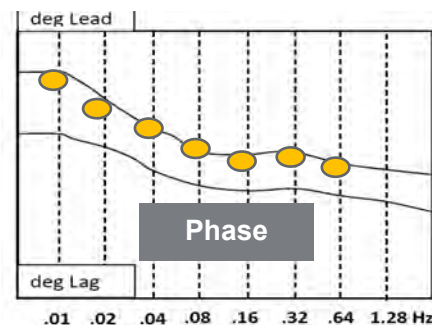
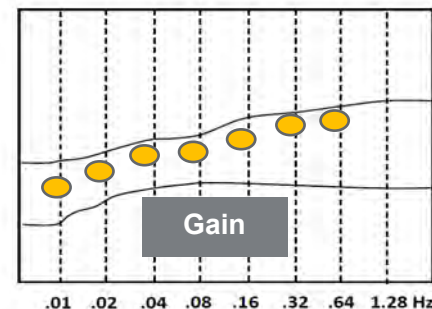


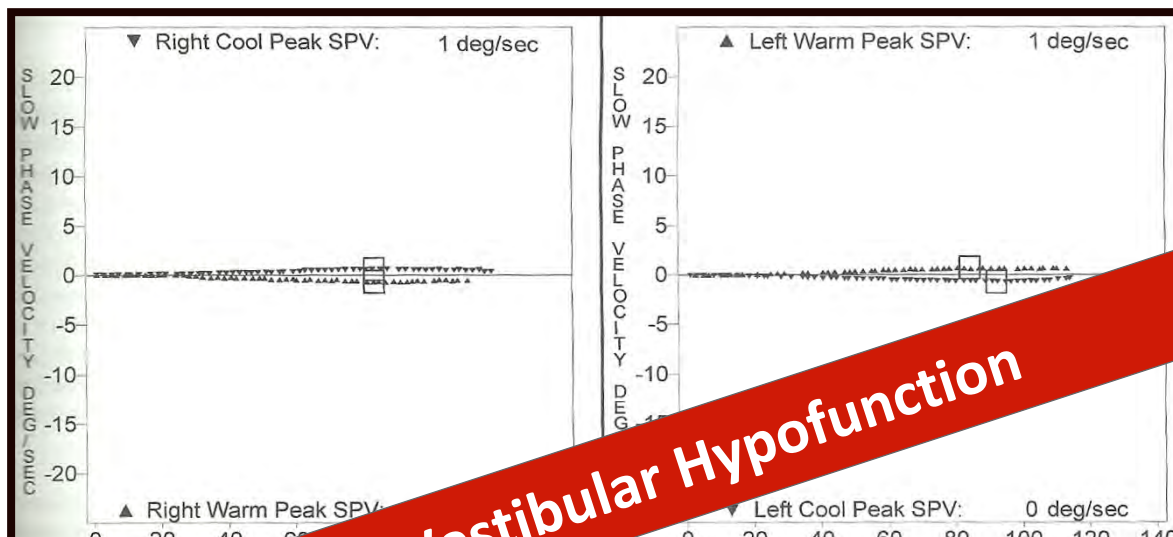
Rotational Chair

- Sinusoidal Harmonic Acceleration (SHA)



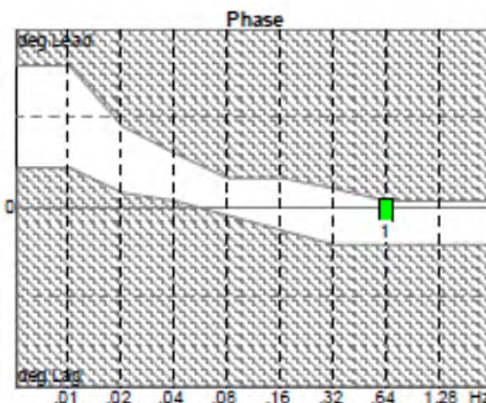
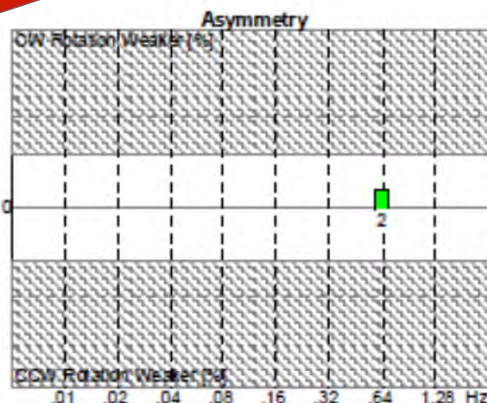
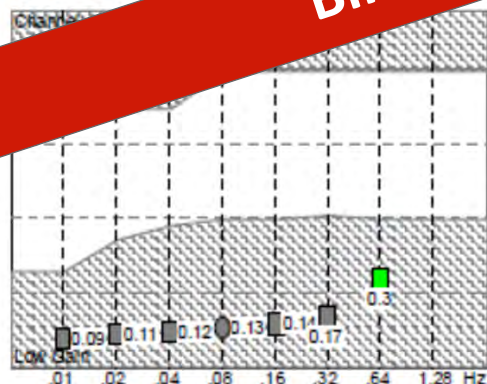
- Examines VOR at different frequencies
- Typical frequencies 0.01-0.64 Hz
- VOR recorded during oscillations (slow phase velocity)



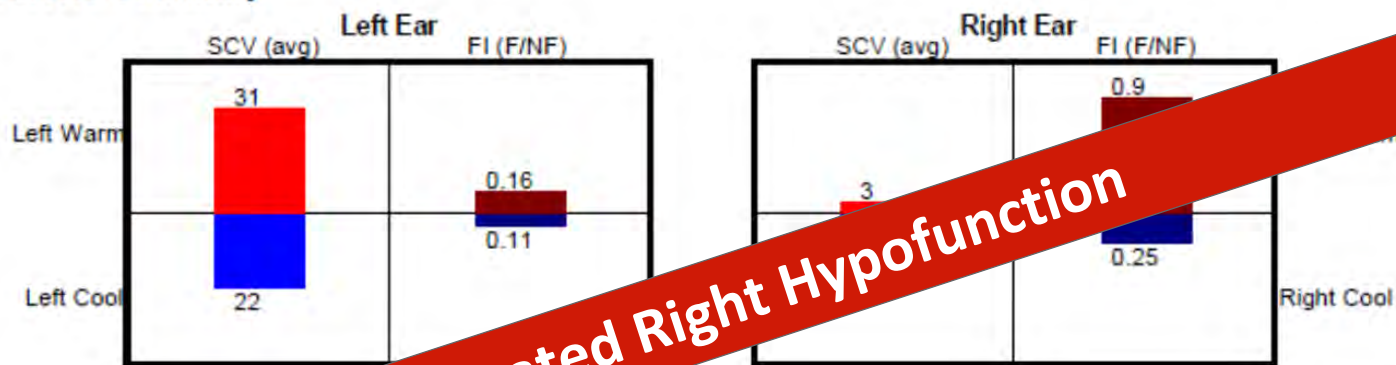


Bilateral Vestibular Hypofunction

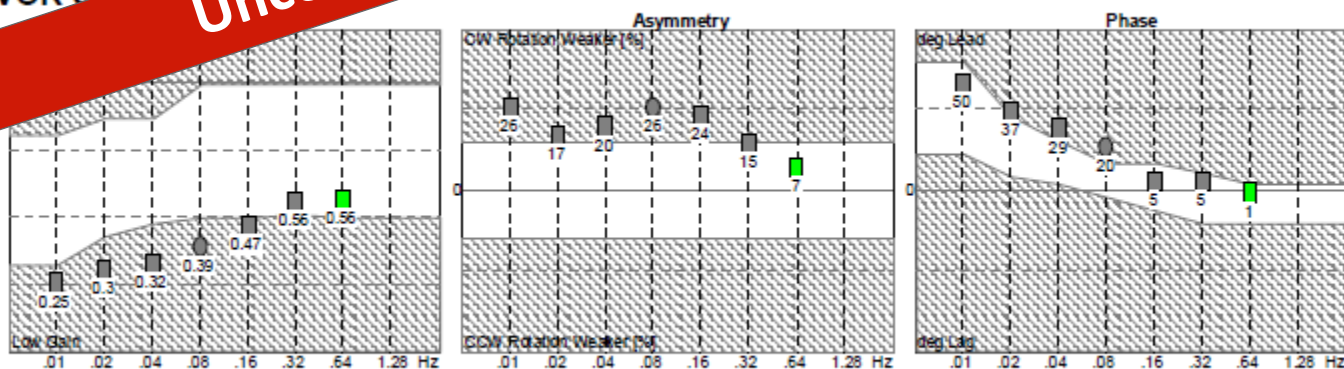
VOR Summary



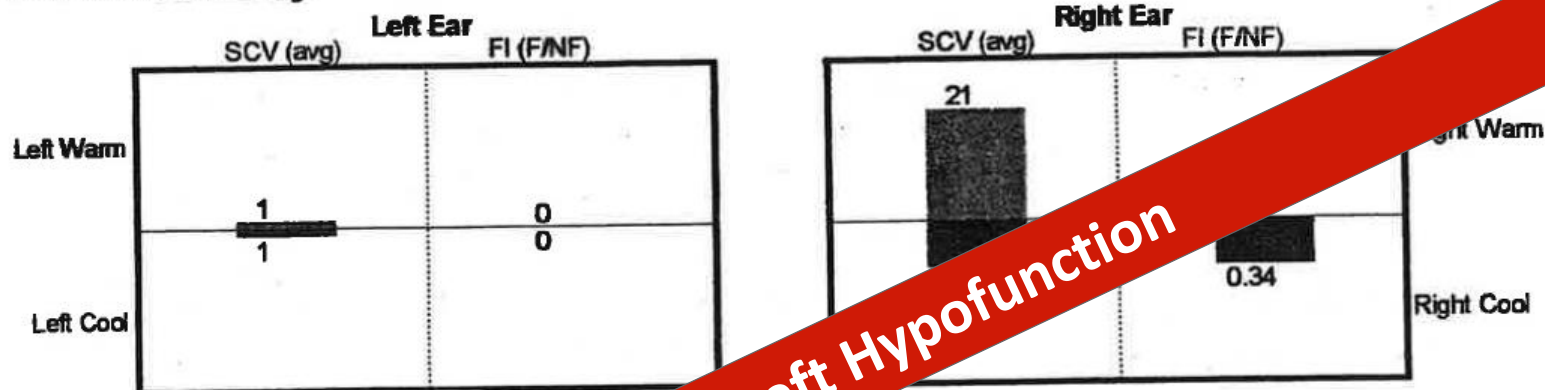
Caloric Summary



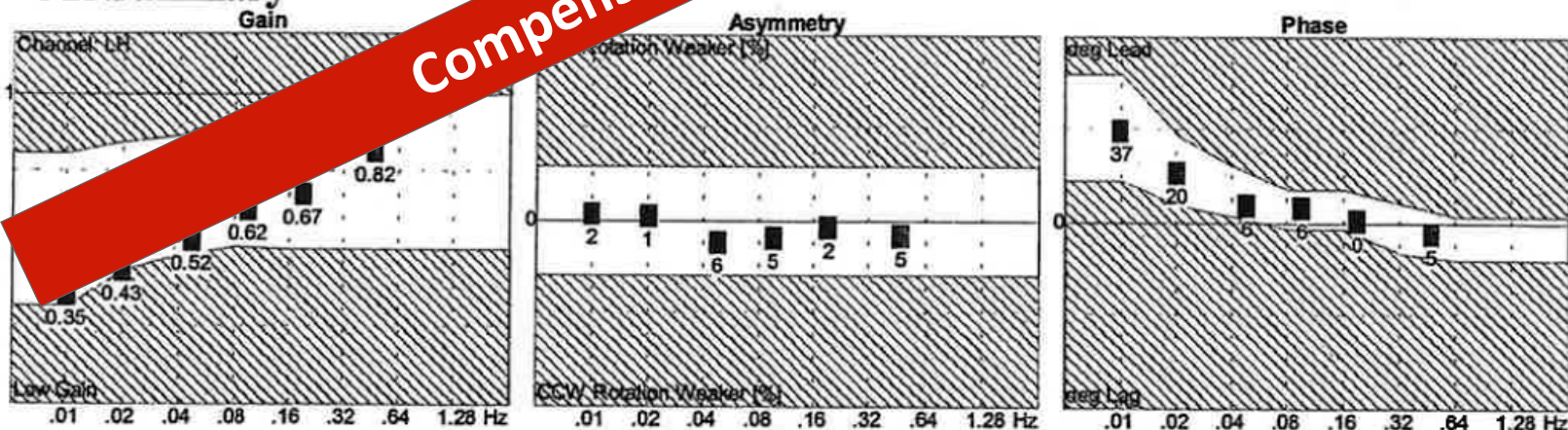
VOR Summary



Caloric Summary



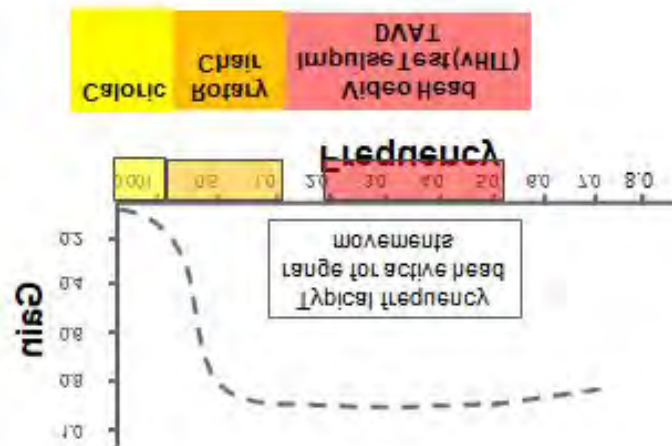
VOR Summary



Compensated Left Hypofunction

Video Head Impulse Test (vHIT)

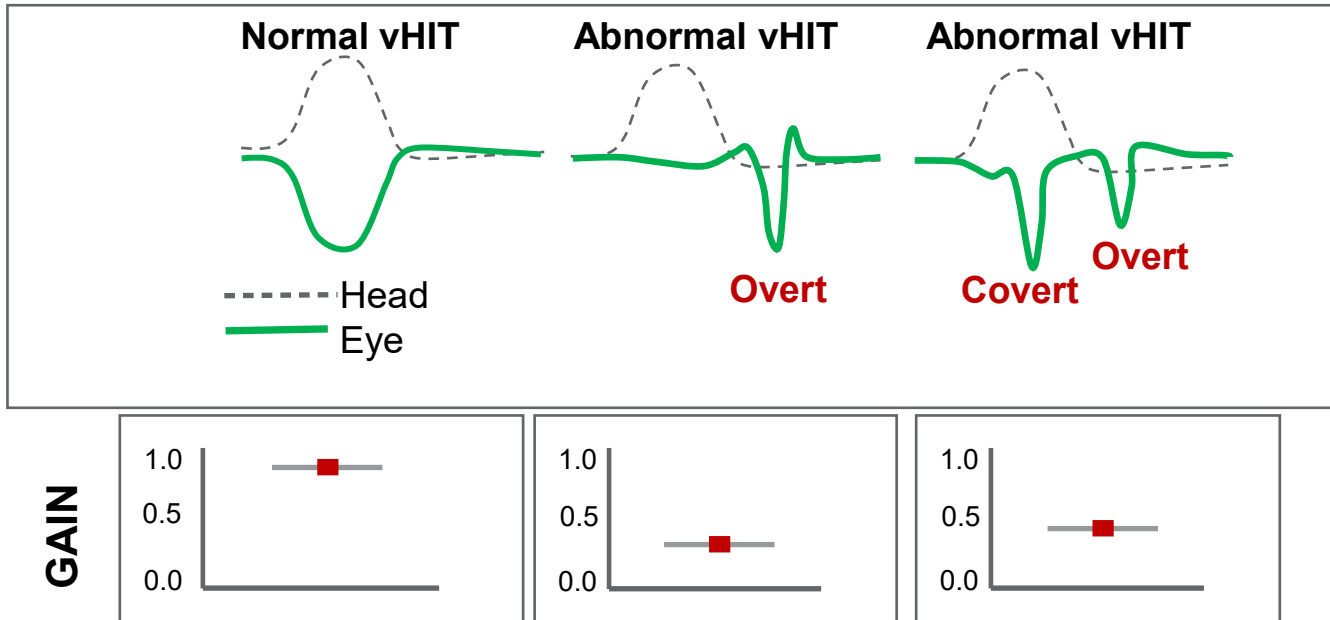
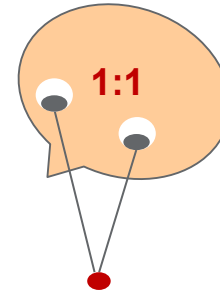
- Objective indication of vestibular dysfunction
- Accelerometer measures head speed
- High speed camera(s) capture eye movements



Important Note

High frequency response of angular VOR (all 6 SCC, inferior and superior vestibular nerve function)

Video Head Impulse Test (vHIT)

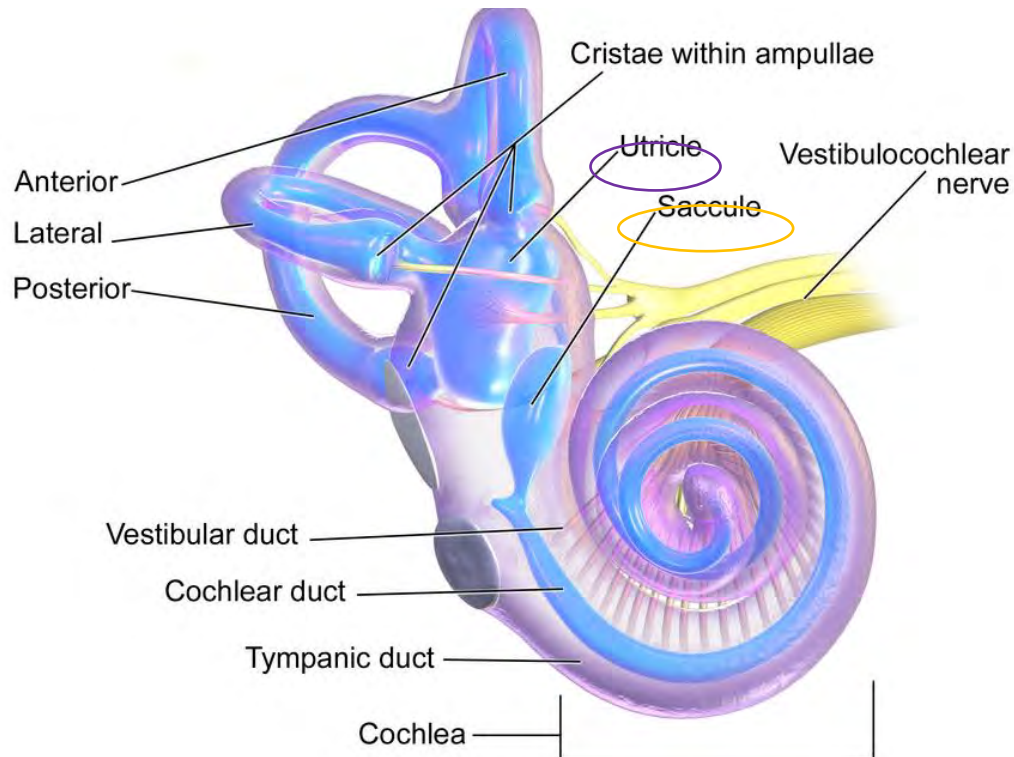


Vestibular evoked myogenic potentials (VEMP)

- Myogenic response recorded from muscles of neck or eyes
- Otolith function

**CVEMP =
sacculle and
inferior nerve**

**OVEMP =
utricle and
superior
nerve**



Important Note

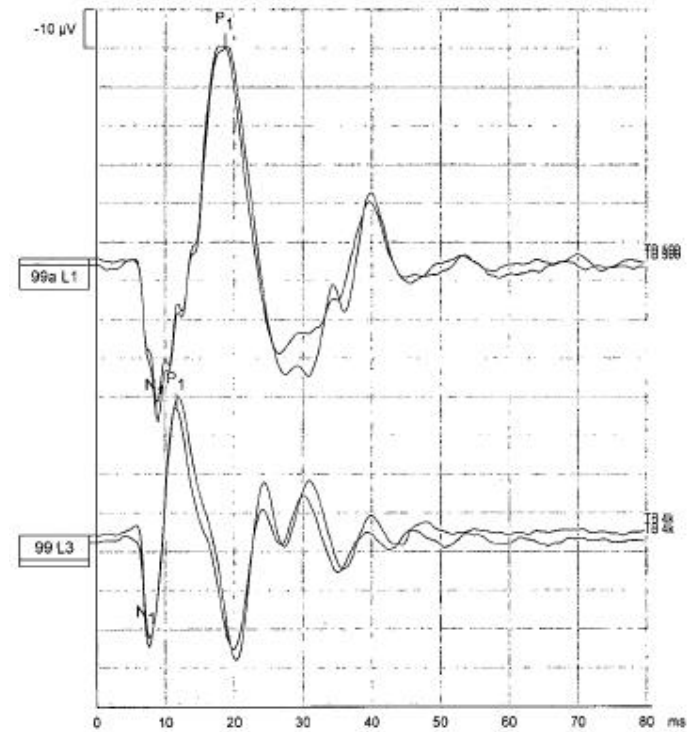
Otoliths respond to loud (e.g., 95dB nHL) and low frequency (e.g., 500 Hz) sounds

Vestibular evoked myogenic potentials (VEMP)

cVEMP



oVEMP



Vestibular Testing Clinical Decision Making Based on Patient Case History

Symptoms	Vestibular Measures
Vertigo triggered with position changes lasting seconds to minutes	Check for BPPV: positional testing
Unsteadiness when walking or standing, increased symptoms in darkness and on uneven surfaces; oscillopsia, lack of sx when sitting/laying down	Check for bilateral vestibular loss: VHIT, VEMPs, Rotary Chair, VNG, DVA
Spontaneous episode of vertigo/imbalance lasting hours to days, resolving to head/body provoked symptoms	Check for unilateral vestibular loss and status of compensation: VHIT, VEMPs, VNG, Rotary Chair (symmetry), DVA etc.
False sense of motion, rocking or tilting, imbalance/disorientation, distorted visual perception	Check for otolith dysfunction: VEMPs, ocular counter roll
Brief symptoms (sec to min) of dizziness, autophony, disequilibrium, oscillopsia, postural vertigo and/or vertigo associated with loud sounds/pressure changes or straining	Check for 3rd window effect: SSCD protocol, fistula testing, valsalvas, Tullio Test, EcochG
Spontaneous episodes of vertigo/imbalance lasting minutes to hours with fluctuating auditory fullness and/or tinnitus	Check for Meniere's: <i>confirm history</i> ; possibly include VEMP testing at 500/750 & > 1000 Hz, calorics, EcochG

Case #1

- Patient symptoms
 - Disequilibrium/ unsteadiness and mild dizziness “brief spins” when lying down and getting out of bed.
 - Previous history of BPPV 2 yrs ago – treated successfully with Epley maneuver on the right side
 - Denies any neurologic or otologic complaints.

Case #1

Clinical hypothesis: BPPV

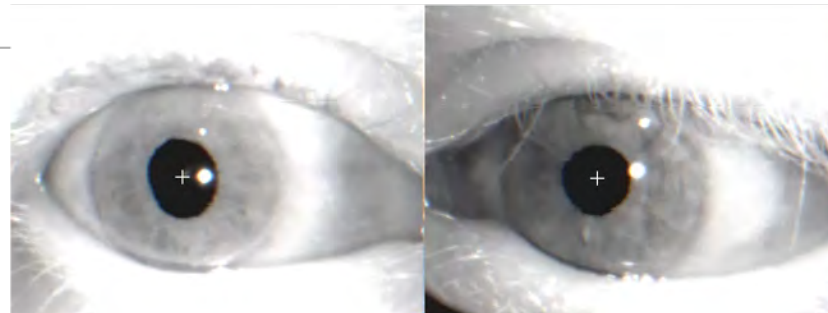
Formulating
the clinical
question(s)

Determine if
we need to
answer the
question(s)

Identify the
tests needed
to answer
question(s)

- Any objective evidence of BPPV?
- If no, any other peripheral vestibular cause for symptoms of imbalance and brief spins with position changes?
- Yes, unable to fully answer questions based on history alone
- **BPPV screening:** Dix-Hallpike maneuvers, positional testing (supine head roll, straight back head hang etc.)

BPPV Signs



- Brief nystagmus with characteristics of the involved SCC provoked with positional testing

Nystagmus Direction	Affected Canal
Upbeat torsional	Posterior
Downbeat torsional	Anterior
Geotropic (right-beat)	The head turn direction presenting with stronger nystagmus indicates the affected horizontal canal
Geotropic (left-beat)	
Apogeotropic (left-beat)	The head turn direction presenting with weaker nystagmus indicates the affected horizontal canal
Apogeotropic (right-beat)	

Case #2

- Patient symptoms:
 - Spontaneous onset of severe vertigo, with nausea and vomiting lasting three days
 - Symptoms have improved with time – no longer experiencing symptoms when at rest
 - Now last for seconds to minutes after head/body movements
 - No auditory symptoms/normal audiogram
 - An MRI was recently completed, which was normal per patient report.

Case #2

Clinical hypothesis: unilateral vestibular hypofunction (e.g. vestibular neuritis)

Formulating
the clinical
question(s)

- Any unilateral peripheral vestibular system involvement? If yes, to what extent (isolated or global loss)?
- What is the status of compensation?

Determine if
we need to
answer the
question(s)

- Yes, unable to fully answer questions based on history alone

Identify the
tests needed
to answer
question(s)

- Side of lesion/status of vestibular loss
- Status of compensation measures

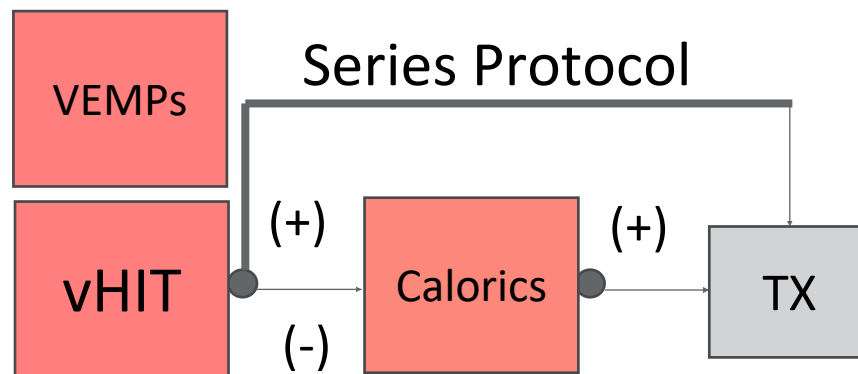
Unilateral Hypofunction Signs

- Unilaterally reduced or absent angular VOR responses: unilateral caloric weakness, reduced vHIT gain with corrective saccades on side of lesion
- Abnormal VEMP testing on side of involvement
- Direction fixed nystagmus enhanced with fixation removed, evidence of directional preponderance
- Vestibular dysfunction pattern on postural control testing

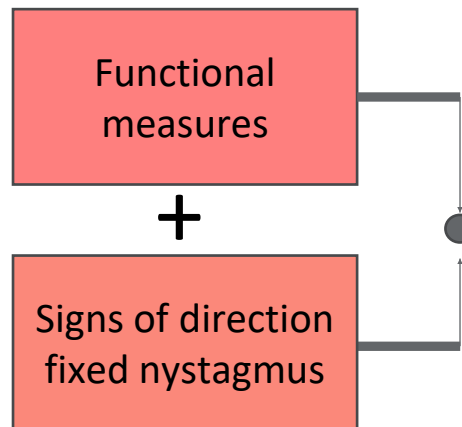
Clinical hypothesis: unilateral vestibular hypofunction

Any unilateral peripheral vestibular system involvement?

If yes, to what extent (isolated or global loss)?



Parallel Protocol



What is the status of compensation?

Case #3

- Patient symptoms:
 - Unstable vision (no double or loss of vision) while walking in particular in dimly lit environments or when floor uneven
 - Asymptomatic when sitting or laying still
 - Visual complaints more noticeable when moving head rapidly or riding in a motor vehicle (described jumbling of the visual surroundings)
 - No auditory symptoms
 - No neurologic symptoms or signs

Case #3

Clinical hypothesis: bilateral vestibular loss

Formulating
the clinical
question(s)

- Is there bilateral vestibular hypofunction to account for patient symptoms?

Determine if
we need to
answer the
question(s)

- Yes, unable to fully answer questions based on history alone

Identify the
tests needed
to answer
question(s)

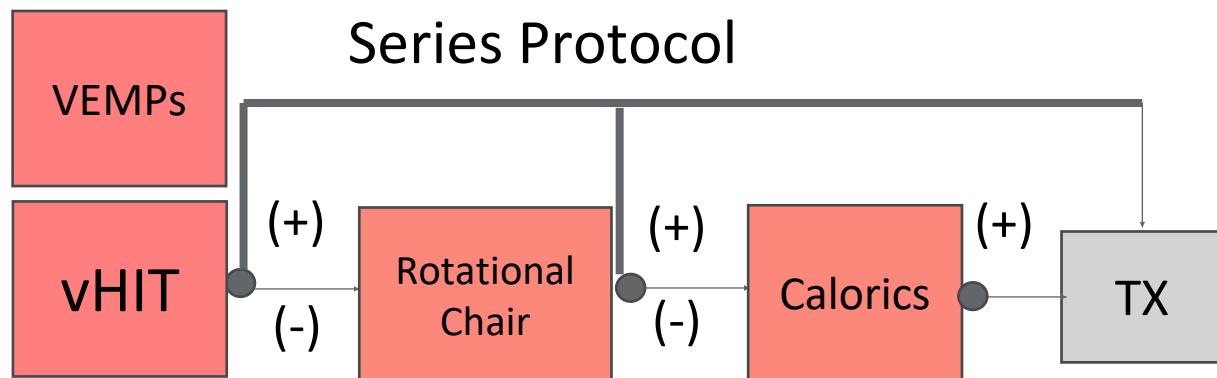
- Rotational chair, DVA, calorics, vHIT, VEMPs
 - Extent of hypofunction (partial, global impairment)
 - Residual function (SHIMP, angular VOR function from low to higher frequency range)

Bilateral Hypofunction Signs

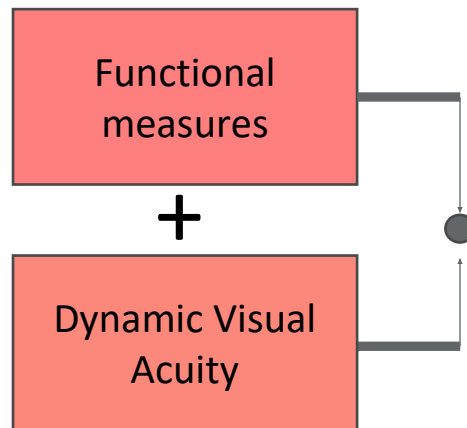
- Bilaterally reduced or absent angular VOR responses:
 - reduced caloric irrigations (Total right ear $< 12^{\circ}/\text{sec}$ SPV and total left ear $< 12^{\circ}/\text{sec}$ SPV)\
 - reduced rotational chair VOR gain
 - reduced vHIT gain with corrective saccades or positive bedside HIT
- Abnormal DVA
- Vestibular dysfunction pattern on postural control testing

Clinical hypothesis: bilateral vestibular hypofunction

Any bilateral peripheral vestibular system involvement?
If yes, to what extent (isolated or global loss)?



Parallel Protocol



Status of compensation

Case #4

- Patient symptoms:
 - Brief symptoms (seconds to minutes) of dizziness
 - Autophony
 - Disequilibrium associated with loud sounds and pressure changes

Case #4

Clinical hypothesis: 3rd Window lesion (SSCD)

Formulating
the clinical
question(s)

- Are there clinical signs of SSCD?

Determine if
we need to
answer the
question(s)

- Yes, unable to fully answer question based on history alone

Identify the
tests needed
to answer
question(s)

- Vestibular evoked myogenic potentials (ocular and cervical)
- Comprehensive Audiometry
- Tullio, Hennebert, Valsalva

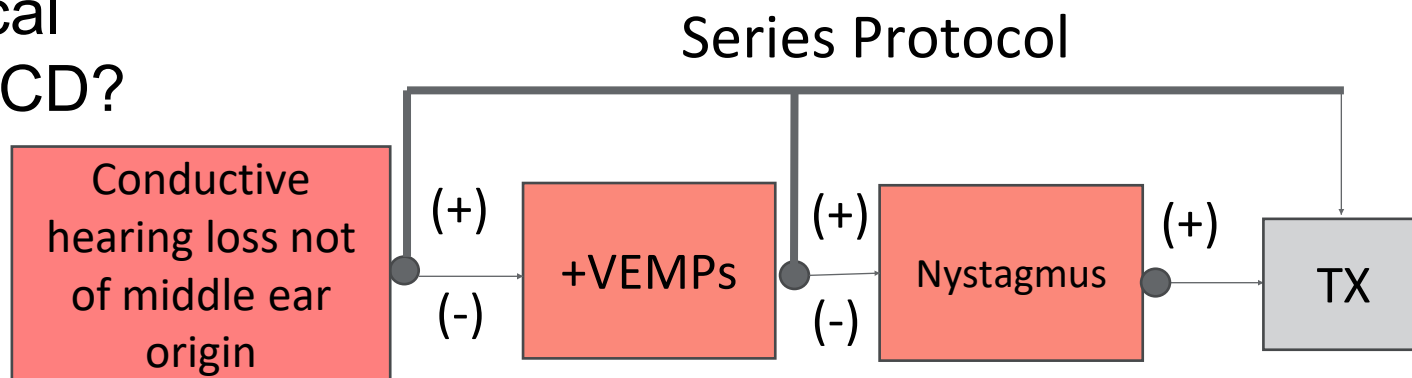
SSCD Symptoms & Signs

- Bone conduction hyperacousis
- Sound and or pressure induced vertigo and/or oscillopsia time locked to stimulus
- Pulsatile tinnitus
- Nystagmus characteristic of excited or inhibited superior canal by sound or pressure
 - (Positive Tullio test, Hennebert sign), valsalva sign
- Low frequency conductive hearing loss not of middle ear origin
- Enhanced VEMP responses

Diagnostic criteria requires at least one of the symptoms and one positive diagnostic test.

Clinical hypothesis: 3rd Window lesion (SSCD)

Any clinical
signs of SSCD?



Summary

- Many causes for dizziness, imbalance, vertigo
- Case history/direct physical examination tools for diagnosis/management
- Vestibular testing useful to confirm hypotheses, further support management decisions
- Critical thinking, planning and questioning needed when selecting vestibular testing

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